shows no signs of decomposition, and unlike the phenolphthalein indicator its concentration is practically avoided. In neutral or acid medium roqui purple gives a deep orange solution, and in alkaline solution it gives a deep purple coloration.

Search in the literature about the pharmacological or therapeutic and medicinal properties of organic compounds possessing similar chemical constitutions to roqui purple gives the idea that it may also possess antiseptic and similar medicinal properties. A study of the pharmacological action of this compound would be, therefore, interesting.

PROCESS OF PREPARATION. A methyl alcoholic solution of phenylhydrazine dinitroderivative distinctly acidified with concentrated sulphuric acid and mixed thoroughly by shaking with a calculated amount of naphthaquinone sulfonate solution in methanol, was refluxed with all universal glass apparatus for several hours on the water bath, after which time the roqui purple precipitated out as red crystals. Several drops of concentrated sulphuric acid and distilled water respectively were then added to complete the reaction. The resulting crystals were recrystalized and purified using absolute methyl alcohol as the solvent. According to the Dumas-Pregl method 4.546 mg. substance gave correct values for nitrogen.

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PHILIPPINE EDIBLE HOLOTHURIANS

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INTRODUCTION

The Philippines has a rich holothurian fauna, of which thirty-nine species, including non-commercial forms, were described by the writer from Puerto Galera Bay and adjacent waters. This list does not include a number of undescribed species found in these regions. Seale's (13) check-list of Philippine holothurians in 1911 gives sixty-six different species, of which fifteen were mentioned in the writer's manuscript (1) (2). There are at present ninety known species and varieties of holothurians which are widely distributed in Philippine seas. They are encountered in waters of various depths, on sandy, rocky, mudsandy, or even grassy bottoms. There is probably no coral reef or island in the Philippine where they are not found in great quantities.

These animals are regularly collected from the Sulu Archipelago in the vicinity of Jolo, Siasi, Bongao and Sitankai, and from the waters around Bohol, Cebu, Bantayan and Negros. There are many places in the Philippines where the *"Trepang"* industry is still undeveloped because the method of collection and preparation for the market is not as yet well understood. These places are Davao Gulf, Palawan and neighboring coral reef islands, the coast of Mindoro, the coast of Luzon, and the shores of numerous small islands of the Philippine Archipelago.

COMMERCIAL HOLOTHURIANS FOUND IN MANILA MARKETS AND OTHER PLACES

Of the twelve varieties of commercial value that are recognized by the Chinese dealers in Manila, only ten species were determined as revealed by an examination of their spicules. The following table is a list of dried holothurians which were obtained from various dealers in Manila with their Chinese names together with their corresponding scientific names as identified by the writer based on the examination of their spicules.

Chinese and Local Names	*Scientific Names*
Oe Liow (Kamotihan)	*Actinopyga echinites* (Jaeger) (*) *Actinopyga mauritiana* (Quoy & Gaimard)
Bah Sim	*Argiodia maculata* (Brandt)
Oh Sim (Buke)	*Argiodia maculata* (Brandt)
Gan Sim	*Argiodia maculata* (Brandt)
Ang Tiow Sim	*Holothuria argus* (Jaeger)
Hea Sim (Patos)	*Holothuria scabra* (Jaeger)
Chea Sim (Makhangkahang)	*Thelenota ananas* (Jaeger)
Che-Hong Che Sim (Cuatro esquina)	(**) *Stichopus chloronotus* (Brandt)
Che Sim (Sorosoro)	*Thelenota ananas* (Jaeger)
Tah Deek Sim or Hong Che (Matinik)	*Stichopus variegatus var. trepangi* var. nov.
Thang Sim (Gamong)	*Holothuria atra* (Jaeger) *Holothuria edulis* (Lesson)
Thoot Sim (Puti)	Undetermined (spicules were dissolved.)

(*) Oftentimes mixed with *Actinopyga echinites.*
(**) Not edible. Used only as fertilizer.

According to Saville-Kent and other sources, the following Philippine species of holothurian are used commercially:

Thelenota ananas (Jaeger) Identified as *Stichopus variegatus* by Saville-Kent)
Actinopyga lecanora (Jaeger)
Actinopyga obesa (Selenka)
Actinopyga echinites (Jaeger)
Actinopyga polymorpha (Bell)
Actinopyga mauritiana (Quoy & Gaimard)
Argiodia maculata (Brandt) (Identified as *Holothuria mammifera* by Saville-Kent)
Holothuria curiosa Ludwig
Holothuria edulis Lesson
Holothuria impatiens (Forskal)
Holothuria vagabunda Selenka
Holothuria pardalis Selenka
Holothuria scabra Jaeger
Holothuria atra Jaeger (identified as *H. sanguinolenta* by Saville-Kent)
Holothuria argus (Jaeger)

Of the fifteen species mentioned above, only twelve have been collected and described by the writer and only ten have been obtained in the Manila markets. The species which was found to be the most expensive is *Actinopyga echinites* (Jaeger). Oftentimes, *Actinopyga mauritiana* (Quoy & Gaimard) has been found to be mixed with this expensive form. A kilo of dred *Actinopyga echinites* (Jaeger) costs from ₱8.00 to ₱12.00 and a single specimen may sell for as much as one peso or even for more. Other species of lower grades are being sold for only ₱0.80 to ₱2.00 a kilo.

METHOD OF COLLECTING, PRESERVING AND DRYING HOLOTHURIANS

The edible holothurians are collected in several ways. The simplest way is by picking them up during low tide and placing them in a sack or in a small banca. During high tide, especially when the sea is calm, they are usually collected from a boat with the help of a single-pronged spear which is provided with a long handle. Another, but harder way of collecting is by diving. This method is followed in collecting the deep-sea forms which are usually the more expensive.

The collected holothurians are then taken to the drying station where they are immediately placed in large kettles or petroleum tin cans and boiled in fresh water for a few minutes. The amount of boiling, however, depends upon the size and kind of holothurians. Each variety requires a special treatment in order to bring out the best flavor. Boiling should continue until they become hard and elastic so that they will dry quickly. They should not be over-boiled as this makes them very soft and hard to dry. After boiling

they are taken out of the water and the viscera removed. This is done by making a longitudinal incision on the body with a long, sharp pointed knife. The smaller ones whose internal organs have been eviscerated during boiling need not be opened. After the viscera have been removed, the trepang are then exposed to the sunshine to dry. In order to hasten drying large specimens are usually spread wide open by inserting pieces of sticks transversely between the body walls. To insure cleanliness and rapid drying, it is advisable to spread them out on plain galvanized iron, *"sawali"* or mats. Sun drying is recommended especially for small scale production where it gives excellent results. This method is, however, slow to be followed for large scale production.

Another method of drying is by smoking especially on a large scale production. A especially constructed smoke house about 10 to 12 feet high and fitted inside with two or three tiers of wire netting to hold the holothurians during the process of smoking is used for this purpose. For roofing and side wall, galvanized iron is preferable. Smoking may last for 24 hours, depending upon the size of the animals. After smoking the trepang are further exposed to the sunshine to insure perfect drying. The wood which is found best for smoking is *"bacauan"* or red mangrove (*Rhizophora muchronata* Linn.), as this burns slowly and does not impart a bad smell to the dry product.

METHOD OF PREPARING HOLOTHURIAN FOR THE TABLE, ETC.

Trepang is commonly served in the form of soup. At first it is cleaned, washed, and minced finely. The fine bits are then soaked in cool water for a few hours and later boiled for an hour. Salt, pepper, butter, and beef or chicken stock is afterwards added. Trepang may be served hot or iced. It can also be roasted and eaten as meat. Some of the smaller forms like *Holothuria pardalis* var. *cebuensis* Domantay are eaten fresh in the form of salad. For salad they are cut into small pieces after the internal organs are removed, and vinegar and spices added. The writer believes that *Holothuria pardalis* Selenka, *Holothuria impatiens* (Forskal), *Holothuria monacaria* (Lesson), *Holothuria curiosa* Ludwig and *Holothuria curiosa* var. *philippinensis* Domantay can also be eaten fresh for the reason that they resemble *Holothuria pardalis* var. *cebuensis* Domantay in size and in form which is good for salad. Besides most of these species were already reported as commercially good, hence edible.

The Chinese consider trepang a very delicious food and even attribute some medicinal properties to certain varieties. For example *Actinopyga echinitis* (Jaeger) is regarded as highly effective in stopping hemorrhage such as excessive menstruation in woman. It is perhaps for this reason that this species commands a high price both in China and in the Phililippines.

In addition to the different species mentioned above, the following though so far not reported edible, are to the opinion of the writer,

may be just as good for food because of their close similarity in flesh with those that were already reported edible. These species are the following:

Actinopyga miliaris (Quoy & Gaimard)
Argiodia maculata var. *tigris* Domantay
Holothuria paradoxa Selenka
Holothuria graeffei Semper
Holothuria marmorata (Jaeger)
Holothuria vitiensis Semper

Occasionally some species of holothurians are reported as being poisonous. Whether the flesh of these is really poisonous or is simply made poisonous through feeding or contamination has not been determined. So far not a single specimen of the poisonous form has reached the writer, so the species cannot be determined.

CONCLUDING REMARKS

Of the nintey species of holothurians known in the Philippines, only a few are being used for food. The larger species with firm and hard body walls are more in demand than the smaller ones. Seale (14) in 1917, reported sixteen principal varieties and forty-seven commercial grades of holothurians in the Philippines. So far the results of my examination of the samples of dried edible holothurians obtained from various Chinese dealers in Manila show that only ten species are commonly used. There are, however, a number of them which are known only in Chinese names and which may belong to different species but because of lack of available samples, they could not be identified.

The Chinese dealers are not accurate in naming a particular variety or grade. It has been noted that a species is known under several Chinese names and varieties. Apparently the system of classification and naming of commercial holothurians depends more upon the size of the samples and the condition in which they are prepared for the market, rather than in their true systematic classification.

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REFERENCES

1. DOMANTAY, J. S. Littoral holothurioidea of Port Galera Bay and a Adjacent water. Natural and Applied Science Bulletin, 1933, v. 3, No. 1

2. DOMANTAY, J. S. Four additional species of littoral holothurioidea of Port Galera Bay and adjacent waters. Natural and Applied Science Bulletin, 1934, v. 4, No. 1.

3. DOMANTAY, J. S. Philippine commercial holothurians. Philippine Journal of Commerce, 1934, v. 10, No. 9.

4. PANNING, A. Die gattung holothuria. Mitteilungen aus dem Zoologischen Staatsinstitut und Zoologischen Museum in Humburg, 1929, v. 44, pt. 1, p. 91-138.

5. PANNING, A. Die gattung holothuria. Mitteilungen aus dem Zoologischen Ctaatsinstitut und Zoologischen Museum in Humburg, Nov. 1934, v. 45, pt. 2.

6. PANNING, A. Die gattung holothuria. Mitteilungen aus dem Zoologischen Staatsinstitud und Zoologischen Museum in Humburg, Nov. 1934, v. 45, pt. 3, 1934.

7. PANNING, A. Die gattung holothuria. Mitteilungen aus dem Zoologischen Staatsinstitut und Zoologischen Museum in Humburg, Feb. 1935, v. 45, pt. 4.

8. PANNING, A. Die gattung holothuria. Mitteilungen aus dem Zoologischen Staatsinstitut und Zoologischen Museum in Humburg, Sept. 1935, v. 46, pt. 5.

9. P. I. BUREAU OF SCIENCE. Division of Fisheries. Notes on the trepang industry of the Philippines. 1931.

10. PEARSON, JOSEPH. Notes on the holothurioidea of the Indian Ocean, Spolia Zeylanica, 1913, v. 9, 34, pp. 49-101.

11. PEARSON, JOSEPH. Notes on the holothurioidea of the Indian Ocean, Spolia Zeylanica, 1914, v. 9, pt. 35, pp. 173-190.

12. SAVILLE-KENT. The great barrier reef of Australia: its products and potentialities, Calcutta, W. H. Allen & co., 1930.

13. SEALE, ALVIN. The fishery resources of the Philippine Islands, Part IV. Miscellaneous marines products. Philippine Journal of Science Series, 1911, Sec. D, v. 6: pp. 283-289.

14. SEALE, ALVIN. Sea-products of Mindanao and Sulu, III. Sponges, tortoise shells, corals, and trepang. Philippine Journal of Science, 1917, Sec. D, v. 12: pp. 191-210.

ILLUSTRATIONS

PLATE I

FIG. 1. *Holothuria edulis* (Lesson); Three dried specimens (trepang), x 1/6.

FIG. 2. *Holothuria edulis* (Lesson); Preserved in formalin, partly contracted, x 1/12.

FIG. 3. *Holothuria argus* (Jaeger); Preserved in formalin, fully contracted, x 1/12.

FIG. 4. *Holothuria argus* (Jaeger); Preserved in formalin, partly contracted, x 1/12.

FIG. 5. *Holothuria scabra* (Jaeger); Dried (trepang), x 1/12.

FIG. 6. *Holothuria scabra* (Jaeger); Drawing from life, x 1/12.

FIG. 7. *Holothuria scabra* (Jaeger); Dried (trepang), x 1/12.

FIG. 8. *Holothuria scabra* (Jaeger); Preserved in formalin, x 1/12.

FIG. 9. *Acitnopyga miliaris* (Quoy & Gaimard); Preserved in formalin and in bad shape, x 1/6.

FIG. 10. *Holothuria atra* (Jaeger); Three dried specimens, (trepang), x 1/6.

FIG. 11. *Holothuria atra* (Jaeger); Preserved in formalin, x 1/12.

FIG. 12. *Argiodia maculata* (Brandt); Preserved in formalin, x 1/24.

FIG. 13. *Argiodia maculata* (Brandt); Dried split open (trepang), x 1/12.

FIG. 14. *Argiodia maculata* (Brandt); Dried (trepang), x 1/12.

FIG. 15. *Holothuria paradoxa* Selenka; Drawing from life, x 1/12.

FIG. 16. *Actinopyga mauritiana* (Quoy & Gaimard), Dried (trepang), x 1/12.

FIG. 17. *Actinopyga mauritiana* (Quoy & Gaimard), Preserved in formalin x 1/18.

FIG. 18. *Actinopyga mauritiana* (Quoy & Gaimard); Drawing from life, x 1/24.

FIG. 19. *Argiodia maculata* var. *tigris* Domantay; Preserved in formalin, x 1/24.

FIG. 20 *Holothuria vitiensis* Semper; Drawing from life by Semper, x 1/18.

FIG. 21. *Holothuria vitiensis* Semper; Preserved in formalin, x 1/18.

FIG. 22. *Thelenota ananas* (Jaegar); Dried (trepang); x 1/18.

FIG. 23. *Thelenota ananas* (Jaegar); Dried (trepang); x 1/12.

FIG. 24. *Thelenota ananas* (Jaegar); Preserved in formalin, x 1/24

FIG. 25. *Stichopus chloronotus* (Brandt); Dried, usually used as fertilizer, x 1/12.

FIG. 26. *Stichopus variegatus* var. *trepangi* var. nov.; Preserved in formalin, x 1/12.

FIG. 27. *Stichopus variegatus* var. *trepangi* var. nov.; Two dried specimens (trepang), x 1/6.

FIG. 28. *Actinopyga echinites* (Jaegar); Preserved in formalin, x 1/12.

FIG. 29. *Actinopyga echinites* (Jaegar); Dried (trepang); x 1/12.

FIG. 30. *Actinopyga echinitis* (Jaegar); Dried (trepang); x 1/12.

FIG. 31. *Holothuria graeffei* Semper; Anterior end; drawing from life, x 1/12.

FIG. 32. *Holothuria graeffei* Semper; Preserved in formalin, x 1/12.

FIG. 33. *Holothuria curiosa* var. *philippinensis* Domantay; Two preserved in formalin, x 1/12.

FIG. 34. *Holothuria impatiens* (Forskal); Preserved in formalin, x 1/12.

FIG. 35. *Holothuria marmorata* (Jaeger); Drawing from life, x 1/12.

FIG. 36. *Holothuria marmorata* (Jaeger); Two preserved in formalin, x 1/12.

FIG. 37. *Holothuria monacaria* (Lesson); Drawing from life, x 1/18.

FIG. 38. *Holothuria monacaria* (Lesson); Two preserved in formalin, x 1/12.

FIG. 39. *Holothuria pardalis* var. *cebuensis* Domantay; Two preserved in formalin, x 1/12.

FIG. 40. *Holothuria pardalis* Selenka; Two preserved in formalin, x 1/12.